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AN ANALYSIS OF MOVEMENT OF 40 FOOT CONTAINERS IN A THEATER OF OPERATIONS

by

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March, 1995

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AN ANALYSIS OF MOVEMENT OF 40 FOOT CONTAINERS IN A THEATER OF OPERATIONS

by

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Submitted in partial fulfillment of the requirements for the degree of

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ABSTRACT

The purpose of this thesis is to analyze the United States Army doctrine regarding the movement of 40 foot containers in a contingency theater of operations. This thesis provides an overview of past challenges presented when shipping 40 foot containers to military operations, as well as current force development trends that are applicable to the movement of 40 foot containers. It examines the effects of employing 40 foot containers on the tactical maneuver units as well as the combat service support and transportation corps functions. Various options are presented regarding the desired locations to ship 40 foot containers, examining the tradeoffs inherent in each option as they pertain to tactical and operational mission accomplishment of combat and combat service support units.

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I. INTRODUCTION

A. BACKGROUND

Transportation of equipment and cargo required by the United States Army has long presented challenges to the military community within the combat service support field. Specifically, the transition to the intermodal container for movement of supplies and equipment has brought with it many challenges as well as efficiencies with which to deal. Among these challenges is the attempt by logisticians to gain increased cargo handling efficiency through the use of containers in transporting supplies and equipment. The containerization movement includes the use of 40 foot containers to transport unit equipment and supplies to contingency theaters of operation. This study is an analysis of the use of 40 foot containers in transporting unit equipment and supplies to Army units in a contingency theater of operations. The area of research is focused toward the Army Transportation Corps and how incorporating 40 foot containers into the transportation plan impacts units being supported as well as the transportation corps.

B. PROBLEM

The objective of this analysis is to review the movement of unit equipment by 40 foot container. Furthermore, this thesis will present different options available to transportation agencies for the use of 40 foot containers and the tradeoffs associated with choosing a particular option. The goal of this tradeoff analysis is to provide commanders in the field more complete information regarding the integration of 40 foot containers into the overall transportation plan. This thesis will explore many questions surrounding the employment of 40 foot containers in a theater of operations. These questions include:

- What is the current procedure regarding movement of 40 foot containers in a theater of operations?

- What are the tradeoffs associated with moving 40 foot containers to different organizational levels in a theater of operations?

- Assuming proposed force structure changes are adopted regarding Army transportation units, what effect, if any, will the new structure have upon the movement of 40 foot containers?

- Is there a unit level boundary across which a 40 foot container should not travel?

- Are there benefits to the Army in either limiting the movement or allowing the free travel of 40 foot containers in a theater of operations?

C. SCOPE, LIMITATIONS, AND ASSUMPTIONS

Because of the extensive varieties and models of containers available for transportation missions, the scope of study and analysis must be limited in nature. Therefore, the discussion will be directed toward 40 foot general cargo containers. The 20 foot container is clearly an integral part of the future transportation mission. (Gipson, Interview, 1994) However, the future role of the 40 foot container is not so easily delineated. (DCSLOG, Information Brief, 6 April 1994)

Furthermore, this thesis will discuss deployment and sustainment of military units in a contingency theater of operations only. During peacetime, time and resource constraints are not as critical when moving materiel via intermodal carriers. As a result, the use of 40 foot containers in peacetime operations is a viable alternative for shipments requiring the volume necessary to fill a 40 foot container.

Additionally, the discussion will focus on Army units only, since a multi-service approach would involve varying

doctrines regarding unit organizations and contingencies too broad to provide effective study.

The three primary areas of interest for the purpose of this thesis are initial surge deployment of organic unit equipment, initial surge of military supplies to the theater, and the continued resupply of a mature theater of operations. In these discussions, the subject of ammunition movement will be treated as a mode of shipment requiring specialized containers and, therefore, will not be discussed in great detail.

This thesis will be primarily conceptual in nature, with information regarding possible options and the tradeoffs of each option outlined. A more specific discussion is precluded by the vast number of scenarios which are conceivable and the permutations which may arise based upon available material handling equipment, etc. Therefore, no optimal solution exists for such broad considerations. It is assumed that those who read or use this thesis will be somewhat familiar with the terms and doctrines of the United States Army and, more specifically, the Transportation Corps.

Several assumptions are relevant to the discussion of this thesis. An initial assumption focuses upon the force modernization and doctrinal changes occurring in the Army Transportation Corps. This thesis is formed under the assumption that proposed force modernization issues discussed later will be approved and implemented by the Army. Furthermore, the new equipment proposed under these modernizations will eventually be fielded to Army units. An additional assumption is that maintaining a high element of customer satisfaction remains a cornerstone of the guidelines for successful execution of the transportation mission within the Army. Therefore, proposed options should attempt to maintain or improve current levels of customer satisfaction while remaining feasible in their execution.

D. METHODOLOGY

Since this thesis analyzes and discusses container policy regarding employment of 40 foot containers, data was obtained through coordination with various agencies in the transportation field. Chief among them was the Combined Arms Support Command (CASCOM), as well as personal interviews with transportation and logistics officers in major commands throughout the Army. Finally, information was received from Headquarters, Military Traffic Management Command (MTMC), and the U.S. Transportation Command (USTRANSCOM). This data was used to form the basis for developing possible courses of action available to responsible agencies for employing 40 foot containers in the transportation plan.

E. ORGANIZATION OF THESIS

Chapter II will provide a background of containerization in the military as well as the new force structures being proposed which affect the container transportation mission.

Chapter III will discuss the model developed for use in deriving courses of action regarding container employment. Included in this chapter will be the criteria developed for creation of the model.

Chapter IV will examine the different courses of action presented and discuss the tradeoffs associated with each option. This chapter will provide detailed analysis regarding the decisions to ship containers to specified echelons in the theater of operations.

Chapter V will be comprised of the conclusions and recommendations for future action.

II. BACKGROUND

Containerization in the military has passed through many refinements in an attempt to streamline the transportation process while improving the timeliness of delivery of supplies and equipment to the unit commanders. Even now this topic is fluid, with numerous papers being drafted by the Combined Arms Support Command (CASCOM) at Fort Lee, Virginia as well as other organizations within the Department of Defense.

When the further effects of military drawdown and budget reductions are factored into the problem, it becomes much more crucial to refine the transportation process to the maximum extent possible. This thesis will now provide a brief discussion of containerization in the military as well as proposed force modernization trends being explored to adapt to the changing military environment with which we are now faced.

A. CONTAINERIZATION IN THE MILITARY

1. Types of Containers

There are many different sizes and types of containers available for use in transporting equipment and supplies. This thesis focuses upon the 40 foot International Standards Organization (ISO) container. However, the issue of container ownership is also a factor in determining where to ship containers. In this context, containers can be owned by the military or commercially. If owned by the military, the military keeps possession of containers even when empty and is responsible for their maintenance and upkeep. If commercially owned, the military merely rents containers for a specified amount of time. The containers used during the surge portion of Operation Desert Shield were primarily military owned, whereas the containers used for sustainment operations were commercially owned. (Green: p.19)

A drawback of commercially owned containers is the issue of detention, or late charges in returning a container to the shipper. While we will discuss this aspect later, it is worthy to note that detention charges may influence decisions regarding how far forward to move containers in a theater of operations. Logically, a container will be delayed longer by traveling to lower echelons than it will if it is immediately unloaded and returned to the carrier at the port.

2. Initial Stages

Containerization may be traced for ocean going purposes to an initial experiment by Pan Atlantic Steamship Corporation, now known as Sea-Land Services, in 1956. Trucking executive Malcolm McLean used two converted tanker ships, loaded containers aboard them, and the concept of intermodal transit of goods began. However, as Muller notes, the blend of true intermodalism, with interchangeable land and sea handling efficiencies, did not flourish for many years. (Muller: p.13)

Prior to 1956, ocean going shipments of equipment and other goods were transported by breakbulk ships, loading and unloading palletized cargo individually over the side of the ship. Such ships were relatively small, took a large crew of stevedores to load and unload the cargo, required vast quantities of blocking and bracing material to secure the cargo, and were very inefficient by today's standards. This point is significant, since Operations Desert Shield and Desert Storm used a relatively high percentage of breakbulk ships to deliver cargo, nearly 35 years after the containerization movement began. (Muller: p.18)

In the civilian market, containers have experienced increasing popularity and growth to the present. As Muller summarizes:

> By 1973, transatlantic trade consisted almost entirely of cargo carried by containership and roll

> on-roll off (ro-ro) vessels except for bulk cargo in bulk cargo ships. Breakbulk vessels were almost completely squeezed out of the transatlantic market, except in certain cases where size and other characteristics of the cargo did not conform to standard container sizes. (Muller: p.17)
>
> Well over 60 percent of the world's deep sea general cargo today moves in containers. The percentage of containerized cargo is even higher between developed countries, approaching nearly 100 percent in some cases. (Muller: p.20)

Department of Defense instructions reflected the growing popularity of containers with the issuance of DoD Instruction 4500.37, Management of the DoD Intermodal Container System, dated 2 April 1987. The Instruction stated that containerized shipment would be the preferred method, unless cost effectiveness or peculiar shipment requirements are an overriding factor. (DoD Instruction 4500.37: 1987)

When the average ship loading and unloading times are compared, it is easy to understand why container ships have grown in popularity over the years. The average breakbulk ship carries 17,000 measurement tons and takes four days to load and four days to unload. On the other hand, a container ship carries an average of 25,000 measurement tons, takes one to two days to load and one to two days to offload. (MTMCTEA Pam 700-2: p.33)

A further factor to consider in the transition from breakbulk ship to container ship is the vessel size. Breakbulk ships are generally smaller than their current container and ro-ro counterparts. As a result, more ships are needed to transport the same amount of cargo that is now shipped by container. This translates into more fuel, more crew costs, higher ship maintenance costs, and lower efficiency for the cargo moved. (RAND: p.4)

3. Ready Reserve Force

As the commercial shipping companies moved toward containerization, the availability of breakbulk ships began to decline. The military, possibly forecasting a future shortage of sealift assets to support contingency operations, bought a large number of breakbulk ships and stored them in the Ready Reserve Force (RRF). As stated in the Center for Naval Analyses Research Memorandum 91-109:

> The Ready Reserve Force is a fleet of militarily useful ships that were purchased by the Navy in the 1980's. The RRF consists of 96 ships, including 17 RO-ROs, 48 breakbulk cargo ships, and an assortment of others like tankers and barge carriers. In peacetime, RRF ships are laid up in a nonoperational status under the control of the Maritime Administration (MARAD). When called up, ships must be towed to a nearby shipyard for mechanical preparations, and crews must be drawn from available U.S. merchant mariners before the ship is turned over to Military Sealift Command (MSC) for operation. The ships in the RRF are split into three groups: those that should be available to activate within five days, within ten days, and within 20 days. As Desert Shield began, 65 ships were in five day status, 28 were in ten day status, and three were in 20 day status. (Center For Naval Analyses Research Memorandum 91-109: p.11)

As we will see below, the shipment of cargo by breakbulk was significant during Operations Desert Shield and Desert Storm. However, the RRF did not meet initial readiness expectations, with ships taking much longer than planned to mobilize. As a result, commercial U.S. and foreign flag carriers shouldered much of the sealift burden. (RAND: p.13)

4. Operations Desert Shield and Desert Storm

The events of Operations Desert Shield and Desert Storm prove how dependent upon the commercial sector the military is for sealift support. During Operation Desert Shield,

3,800,000 tons of dry cargo was shipped by sea. Of this amount, 20 percent was shipped by container ships. (Mitre Corporation: 1991)

With such a large amount of supplies moving by breakbulk ship, the load on the logistics system was increased regarding the manpower requirements to handle the palletized cargo. This cargo was transshipped at the sea port of debarkation, moved to a storage area and unloaded from trucks, sorted by unit, and then moved to a further storage area at the corps area. From there, it was handled again, offloaded from the truck and placed in a holding area for units to pick up. This move is contrasted by the ideally packed and marked 20 or 40 foot container, which moved from the port directly to the corps storage area or to the division owning the equipment. (Gipson, Interview, 1994) The cargo handling efficiency differences are apparent in this example.

Part of the reason for a lack of container ship usage was the consideration that no formal doctrine existed which discussed the use of commercial ships in a practical manner. The system was not completely in place to get containerships on short notice without disrupting the commercial transportation system. Therefore, the military reverted to the breakbulk methods tried and proven in the past. (Cochran, Interview, 1995)

A further consideration in the large number of breakbulk ships used was the lack of a significant inventory of U.S. flagged ro-ro vessels. The military is required to move on U.S. flag carriers with U.S. crews under normal conditions. Most of the ro-ro and container vessels available for use during Operations Desert Shield and Desert Storm were either foreign flagged or foreign crewed. Thus, the RRF became the only available short notice choice. (Cochran, Interview, 1995)

5. Mobility Requirements Study

As part of the solution to the labor intensive breakbulk operations, the Department of Defense directed a Mobility Requirements Study be undertaken in 1991. The Mobility Requirements Study determined that sealift capacity was inadequate to meet future sealift contingency needs. It recommended the purchase of 19 Large Medium Speed Roll-on Roll-off vessels (LMSRs). These vessels would provide adequate lift capacity to meet future operations without reliance on the breakbulk ships as was the case during Operations Desert Shield and Desert Storm. Also recommended was the pre-positioning of equipment and containers in various locations worldwide. This aspect will be discussed in a subsequent section. (Price, Interview, 1995)

6. Industry Trends

The container industry continues to move toward areas of efficiency and increased productivity. As stated by Coyle, Bardi and Cavinato:

> The time would appear ripe for significant growth in intermodal traffic. Railroads, airlines, motor carriers, and water carriers have all shown signs of their service in the intermodal area. (Coyle, Bardi, and Cavinato: p.469)

A by-product of this move is the preference by commercial ocean carriers of the 40 foot container instead of the 20 foot size. This push toward the larger size has been occurring since the 1980's but is again receiving attention in the military community. The 40 foot container is more efficient for commercial carriers to transport because of the reduced number of handlings to move the same amount of equipment. A 40 foot container requires only one move to load or unload from a ship, whereas two 20 foot containers must be moved to lift the same volume or weight. (Pittman, Interview, 1995)

7. Army Doctrinal Developments

a. *Unitization*

Just as their civilian counterparts have done, the military is attempting to increase efficiency in container and cargo handling operations. A key development is the concept of unitization of cargo.

Unitization refers to the shipping of a full package of a particular commodity in a container for a specific organization. Using food as an example, the current method of shipment is to fill a container to capacity with a single commodity, such as a breakfast meal. The full container of breakfast then moves to a staging location, where it is unloaded, divided into smaller sections, palletized with the lunches and dinners that arrived in separate containers, and then shipped to the final destinations. The unitization concept would ship all of the meals as a group, putting breakfast, lunch and dinner in a single container. In this manner, the forward locations would be required to handle only one container instead of three. (Fox, Interview, 1995)

An important factor in the unitization effort is loading containers to capacity. When a load prepared for shipment is less than a container load, the shipper must take the cargo to a container control point, where it will be loaded with other items to make a full container load. The fully loaded container would then be shipped to the theater of operations. (Concept for Container Movement Using AIT: p.4, 4 November 1994) This occurrence is contrary to the goals of unitization.

Since the trend is toward unitization, the 20 foot container is ideally suited to this purpose. The 40 foot container under this concept would likely be suboptimized, wasting valuable cargo space that could be taken up by smaller 20 foot containers. Therefore, the 40 foot container does not

appear to be compatible with the unitization goals on a company or battalion level scale. (Fox, Interview, 1995)

Additionally, the unitization concept using 20 foot containers complies with current Army regulations, which call for the 20 foot by eight foot by eight foot container to be the Army standard container for unit equipment shipments. However, the regulation does allow for the use of larger containers in contingency or mobilization operations. (Army Regulation 56-4: 1990)

b. Army Strategic Mobility Plan

In addition to the areas discussed above, the military has been revising container doctrine to reflect the mobility requirements as well as budgetary and manpower constraints. Part of that doctrine attempts to define the role of the 40 foot container in deployment operations. The Army Strategic Mobility Plan is attempting to make the 20 foot container the Army standard in transportation movements. (DCSLOG, Information Brief: 6 April 1994)

The apparent dichotomy in the direction the military and civilian communities are traveling means that further planning must be undertaken regarding the role of the 40 foot container. One option posed was that the Army consider purchasing 20 foot containers and keeping them at a central point for units to draw when needed. (Pittman, Interview, 1995) However, this will probably not eliminate the 40 foot container in military transportation operations. According to COL Ebertowski, "The 40 foot container is becoming the standard in the industry. Buying 20 foot containers can't close them out." (Ebertowski, Interview, 1995)

8. Container Purchase

Under the Army Strategic Mobility Plan, Military Traffic Management Command (MTMC) will purchase containers for use by military units based upon validated requirements under contingency operations. (Gipson, Interview, 1995)

During the latest deployment to Southwest Asia, named Operation Vigilant Warrior, the 24th Infantry Division needed 125 20 foot containers for their initial force movement. The division purchased the containers from commercial vendors. However, because of the short lead time, containers were purchased at a premium price. Additionally, some of the containers were in less than peak condition. As a result, the division had to pay for the repair of some containers in order to deploy. (Driver, Interview, 1995)

Again, it is worthwhile to note that all containers purchased were 20 feet in length. However, once in theater, the unit began seeing 40 foot containers as resupply items were shipped. Thus, the 40 foot container was a factor in the operation. (Driver, Interview, 1995)

9. Containerization In Haiti

As events in Haiti and Southwest Asia demonstrate, the container shipping problem has still not been completely resolved. Lessons learned from Operations Desert Shield and Desert Storm are being applied, but the process is not complete.

In the movement of containers to Haiti, units moved containers down to the company level. Based upon the mission requirements, some containers were not opened for weeks at a time. The containers, therefore, became storage areas for unit equipment. (Schoen, Interview, 1995)

The container of choice for these movements was the 20 foot container. In fact, the 20 foot container was used almost exclusively until commercial vendor supplies began diminishing. An additional factor contributing to the eventual use of 40 foot containers was the workload on the civilian shippers having to effectively double their handling tasks by moving the 20 foot instead of the 40 foot container. These factors were the key elements impacting the decision to begin using 40 foot containers. (Schoen, Interview, 1995)

B. CONTAINER DISTRIBUTION SYSTEM

Cargo and equipment moved by transportation units in a theater of operations is governed by the cargo distribution system. The distribution system is defined as:

> ...that complex of facilities, installations, methods, and procedures designed to receive, store, maintain, distribute and control the flow of military materiel between the point of receipt into the military system and the point of issue to using activities and units. (JCS Pub 1-02, 1989)

The movement of containers impacts all areas of this system. However, current doctrine does not provide a description of container management and distribution. (Concept for Container Distribution: 1994) Containers must be moved as far forward in the theater as possible to take advantage of the cargo handling and transportation efficiencies they provide. (Ebertowski: p.10) Ideally, the container would be moved to the final destination before being removed from the truck and unloaded. (Gipson, Interview, 1995) However, the process of container shipment varies according to whether the equipment is organic to the unit or a general resupply container.

1. Organic Unit Equipment

Organic unit equipment is that equipment which deploys with the unit from their home station to the area of operations. It may include vehicles as well as supplies.

Based upon the author's personal experience, containerized organic unit equipment was moved during Operations Desert Shield and Desert Storm to the division level, as requested by unit commanders. The battlefield location of many of these containers was the Forward Assembly Area (FAA) at the Division Support Command (DISCOM), the location occupied prior to assuming final attack positions for the assault into Iraq and Kuwait. However, little

consideration was given to how the containers would be handled at such forward locations. The current distribution system did not adequately address this aspect of container operations, and a subsequent shortage of material handling assets existed. It then became a hunt throughout the area for any available container handler that could be used for moving and consolidating containers.

Twenty foot containers were sometimes downloaded with the M88 tracked vehicle heavy tank retrievers found in heavy divisions, using chains for slings. However, the 40 foot containers were too large to safely attempt handling with the M88. To solve the 40 foot container movement dilemma, a Rough Terrain Container Handler (RTCH) was borrowed from any unit who would release one to perform the container movement mission. Clearly, this was not the routine method of obtaining container handling support. However, the Corps Movement Control Center and Movement Control Teams did not have sufficient assets to allocate handlers to each requesting division. As LTG Pagonis stated:

> We need improvement in two general areas: first, in the category of rear area equipment, which can be solved with buying or renting commercial equipment; and second, in the category of rough-terrain, forward equipment, which is more specialized, isn't normally available in the host nation civilian economy, and must therefore be brought into the theater by the armed forces. (Pagonis: p.205)

2. General Resupply

Equipment classified as general resupply includes repair parts, food, and other classes of supply. These items are usually designated for specific units, but the units did not bring the items with them.

> Current distribution doctrine only flows containers to the Theater Storage Area (TSA) and the Corps Storage Area (CSA), where contents are unstuffed, sorted, repackaged and moved to the using unit. (Ebertowski: p.11)

Based again upon the author's experience during Operations Desert Shield and Desert Storm, the equivalent location was the logistics base in the Corps or Echelons Above Corps (EAC) area. From there, depending on the type of material, the contents were either sent to the units at the division level or the units came to pick up their supplies at the logistics bases. For divisional units, the drive to a logbase in order to retrieve their supplies could be as long as six hours one way. This aspect of operations made retrieving supplies relatively inefficient for the unit commanders.

C. FORCE MODERNIZATION TRENDS

The issues raised in the background sections above are largely tied to a shortage of material handling equipment to process containers through the distribution system. Much of this can be traced to the philosophies developed since 1983 regarding Combat Service Support (CSS) operations in general and container operations specifically.

> In 1983, the Army developed a force structure called The Army of Excellence which resulted in a very lean CSS force structure. The Logistics Unit Productivity System (LUPS) program supported this restructuring and 29,000 CSS personnel spaces were traded off for 762 million dollars of equipment which was to enable the CSS units to increase their productivity with less people. The problem is that in most cases, the new equipment was not bought and the personnel spaces taken out were not replaced. (Ebertowski: p. 22)

> In reviewing the LUPS program, GAO found that, as of February 1990, about half of the 390 logistics

> units in the LUPS program were considerably short equipment and manpower. In February 1990, the Army reviewed the personnel and equipment status of the LUPS units and found that 138 of the 239 units reviewed were too short equipment and or personnel to achieve the minimum "C-3" readiness rating. (Ebertowski: p. 22)

The equipment and personnel shortages noted above, along with the changing world scenario, led the military to explore new ways of accomplishing the transportation mission. An important part of this mission refinement involved the aspect of shipping containers to forward deployed units. In this context, forward deployed units refers to units within the tactical level of war. A description of the strategic, operational, and tactical levels of war will assist in illustrating the magnitude of the issues involved.

1. Strategic Level of War

The strategic level of war is defined as:

> The level of war at which a nation or group of nations determines national or alliance security objectives and develops and uses national resources to accomplish those objectives. Activities at this level establish national and alliance military objectives; sequence initiatives; define limits and assess risks for the use of military and other instruments of power; develop global or theater war plans to achieve those objectives; and provide armed forces and other capabilities in accordance with the strategic plan. (AFSC Pub 1: p. I-38)

2. Operational Level of War

The operational level of war is defined as:

> The level of war at which campaigns and major operations are planned, conducted, and sustained to accomplish strategic objectives within theaters or areas of operations. Activities at this level link tactics and strategy by establishing operational objectives needed to accomplish the strategic objectives, sequencing events to achieve the operational objectives, initiating actions, and

> applying resources to bring about and sustain these events. These activities imply a broader dimension of time or space than do tactics; they ensure the logistics and administrative support of tactical forces, and provide the means by which tactical successes are exploited to achieve strategic objectives. (AFSC Pub 1: p. I-32)

For the purpose of discussion, we will use Operations Desert Shield and Desert Storm as an illustration of the operational level of war. In this case, the theater in the Middle East may be considered the operational level, with the sea ports of debarkation being included in this level of war as well. Additionally, many of the logistics bases would fall into the operational category, since they were above the Corps level in their organization.

3. Tactical Level of War

The majority of this thesis will focus upon the tactical level of war. The tactical level of war is defined as:

> The level of war at which battles and engagements are planned and executed to accomplish military objectives assigned to tactical units or task forces. Activities at this level focus on the ordered arrangement and maneuver of combat elements in relation to each other and to the enemy to achieve combat objectives. (AFSC Pub 1: pg. I-41)

At the tactical level, the largest element is the Army Corps. As summarized in Field Manual 100-5:

> Corps are the Army's largest tactical units, the instruments with which higher echelons of command conduct maneuver at the operational level...they contain all the organic combat, combat support, and combat service support capabilities required to sustain operations for a considerable period. (U.S. Army Field Manual 100-5: p. 185)

4. Container Handling Equipment

Few units below the Echelons Above Corps (EAC) level are authorized the Rough Terrain Container Handler (RTCH). As a result, many of the efficiencies gained from container transport were lost during Operations Desert Shield and Desert Storm by having to open containers at the port of debarkation and send the contents forward to the Supply Support Activities (SSAs). (Ebertowski: p. 38)

This shortage of material handling equipment below the Corps level is still prevalent today. When discussing the capability to receive and use 40 foot containers in forward locations, commanders of division level main support battalions do not have a problem solely in receiving the containers. Rather, the shortfall is primarily in the lack of material handling equipment required to unload and load containers at the support battalion level. A proposed solution was to place the rough terrain container handler at locations where forklifts are currently authorized in order to allow the handling of containers. Without the capability to offload and load the containers, there is little to no benefit in shipping the containers to forward locations. (Boles, Interview, 1995)

The difficulty with the position proposed above is the fact that divisions are required to be inherently mobile. Even the heavy division is required to move quickly and be able to perform any tactical mission assigned. (FM 100-5: p. 185) The RTCH is not easily transportable, so it is difficult to move. As a result, the division may become too heavy and sacrifice mobility. (Ebertowski, Interview, 1995) Additionally, it is doubtful that the Army would spend the funds necessary to place a RTCH with all of the support and maintenance personnel at each division to accomplish this mission.

Such an option may be monetarily infeasible, but the Army is proposing a force structure modernization under the container distribution system which, among other things, would create a new Cargo Transfer Company to help offset this shortage.

5. Cargo Transfer Company

As stated above, the Cargo Transfer Company (CTC) is a proposed force modification that would allow for a more flexible response in handling containers at the corps level and below. A summary of the capabilities of the CTC is now discussed.

The CTC will replace the current Terminal Service Company (Breakbulk), Terminal Service Company (Container/Breakbulk), and the current Cargo Transfer Company, providing increased flexibility in handling the types of cargo now seen in the military. (Draft Cargo Transfer Company URS: 1994)

The mission capabilities are chiefly expanded to incorporate more container handling capabilities while slightly reducing the number of personnel required in the company. This initiative is similar in concept to the LUPS program only in the aspect of increased equipment and slightly decreased personnel. The major equipment change is the generated requirement for an additional 79 RTCHs Army wide. (Gipson, Interview, 1995)

The missions performed and a suggested scenario of employment of the CTC is outlined as follows:

> Under the Army Strategic Mobility Plan, these units and the Port Operations Cargo Detachments will have equipment prepositioned and will deploy between C+4 and C+10 to begin discharge of units and supplies. At the seaport four of the companies and all of the detachments will initially discharge the ships that have been prepositioned. (Draft URS: 1994)
>
> As the operation develops into the sustainment phase and theater development, cargo handling operations at the SPODs will be assumed by either

> follow-on units or contract support/Host Nation support under MTMC. The cargo handling companies will then be available to corps and division units requiring additional CHE/MHE to meet surge requirements. Units originally assigned to theater may be reassigned to the corps during this transition. (Draft URS: 1994)

An element of note is the plan to initially provide the CTC at EAC level only. Only after the theater is more developed would the CTC assets be available to levels below EAC for missions. This support, based upon the discussions above, would more than likely be in a general support (GS) role for units below the corps level. In other words, a particular division would not receive a RTCH on a permanent basis, but only as needed and based upon the priorities of the corps. This aspect is significant when discussing the handling of 40 foot containers, since the division will still not have organic equipment it can count upon with certainty to offload and move containers.

In summary, the CTC proposals should help alleviate the problems previously experienced at the division level. However, there is still enough uncertainty about container handling capabilities to cause concern at levels below EAC on where to send the 40 foot container.

6. Palletized Load System

The Palletized Load System (PLS) was designed initially to move ammunition pallets around the battlefield. The system consists of a pallet or flatrack that can be dismounted from a truck chassis, loaded with equipment, and then retrieved by the truck for movement to other destinations. It was designed as a cross country vehicle with excellent mobility characteristics. The current PLS trucks are configured either with or without mounted cranes. Those trucks without mounted

cranes cannot pick up pallets organically; they must have material handling support to lift the pallets. (Price, Interview, 1995)

Current efforts are underway to modify the PLS truck to handle containers. The PLS truck with a flatrack can carry a 20 foot container, but the gross weight of the container and cargo is approximately 16 short tons. This limitation is due to the fact that the flatrack must be used in conjunction with the container. The result is a diminished cargo capacity. Furthermore, the system would require equipment at origin and destination to handle the container. (Price, Interview, 1995)

A more significant negative factor regarding the PLS truck for container operations, however, is the fact that it cannot carry a container as currently configured and meet the height restrictions of many overseas countries. In effect, the mobility is constricted by height restrictions under overpasses. (Price, Interview, 1995)

Regarding the use of PLS for transporting 40 foot containers, the current system does not have that capability. Research and feasibility studies are underway to ascertain the possibility of such a modification, but initial prospects are unclear as to whether modifications can be made on such a large scale. (Price, Interview, 1995)

7. Self Loading/Unloading Trailer

A development on the horizon in the transportation industry is the development of a self-loading and unloading semitrailer. This trailer would be able to drop off and pick up containers anywhere in the theater of operations with no external support required. The key aspect of this trailer would be the fact that no external material handling equipment would be required to load or unload containers. If fielded, this system would greatly reduce the manpower and equipment requirements for handling containers in any contingency. A proposed fielding would occur incrementally, with the new

trailers gradually replacing older semi-trailers in the Army inventory. The mission needs statement has been approved to begin the acquisition process, and feasibility studies are underway. (Price, Interview, 1995)

8. Equipment Prepositioning

Current military doctrine as espoused under "Force XXI" states that:

> America's strategic mobility capabilities are hinged on a critical triad consisting of equipment pre-positioning, strategic sealift, and airlift, supported by world-class power projection installations. The first leg of the triad is pre-positioning. (Army Focus '94: p. 29)

The value of prepositioning equipment and supplies was discussed in a Government Accounting Office report on Operations Desert Shield and Desert Storm:

> During Operation Desert Shield, the availability of U.S. prepositioned assets proved important. These assets included material-handling and transportation equipment stored aboard U.S. ships and at land sites in the Middle East. (GAO/NSIAD-92-20: p.3)

As noted previously, the CTC is envisioned as arriving in theater between C+4 and C+10 using pre-positioned equipment. Therefore, the pre-positioning of equipment is worthy of note. The eventual goal of the pre-positioning program is to be able to field over four divisions of equipment from pre-positioned stocks. (Ebertowski, Interview, 1995)

Part of this program is the aspect of pre-positioning container ships with supplies, ammunition, and other items needed for rapid response to a theater of operations. Currently, the containerships Titus and Gibson are preparing to load containers for pre-positioning in Diego Garcia. Both ships will have full complements of containers. However, all containers scheduled for pre-positioning are 20 feet in

length, with no provisions for 40 foot containers. (Ebertowski, Interview, 1995) This reflects the Army position discussed earlier of attempting to limit container use to 20 foot lengths only.

D. CHAPTER SUMMARY

In summary, the Army has lagged behind civilian industry in their use of containerization as a transportation asset. Additionally, the military and commercial sectors appear to be charting divergent courses, with the commercial industry moving toward 40 foot containers as an industry standard while the Army is attempting to establish the 20 foot container as the transportation standard.

Even with Army efforts to establish a 20 foot container standard, the 40 foot container has nevertheless played a significant role in recent deployments to various locations. History has demonstrated that the 40 foot container is probably going to be a part of transportation operations in any future contingency.

Current force modernization trends are attempting to grapple with the fact that 40 foot containers are an integral part of the transportation system. The research into PLS modifications as well as the initiative in developing a self-loading and unloading semi-trailer demonstrate the Army's recognition that 40 foot containers will be employed in future operations. The proposed Cargo Transfer Company also demonstrates the Army's commitment to providing container handling support to lower echelons of command.

Equally obvious is the difficulty in determining where on the field of battle to send the 40 foot container. The military has made great strides in tracking containers, but dealing with information about cargo is easier than dealing with the cargo itself. (Reengineering the Defense Transportation System: p.15) Customers want the containers,

but only if it is possible to handle them. Containers have traveled from the port to the company level, and all points in between. Therefore, a dilemma exists regarding the employment of 40 foot containers within the theater of operations.

III. MODEL DEVELOPMENT

A. CRITERIA

Based upon the information previously presented, the ground commander and transportation agencies must have a set of clearly defined options from which to choose in determining the proper location for shipment of 40 foot containers. In developing a list of options available, several criteria emerged which must be considered. These are:

- Service to the customer.
- Force level requirements for transportation assets.
- Effect upon road network congestion.
- Efficiency of material handling operations.
- Optimization of the container capacity.

1. Service to the Customer

Since transportation operations are usually classified as service operations in nature, this element is an important criterion when examining possible courses of action for shipment of the 40 foot container. An integral aspect of good customer service is providing service which allows the customer to remain capable of accomplishing his assigned missions. The transportation of equipment and supplies should not adversely affect this ability and, if possible, should enhance the customer's ability to perform assigned tasks effectively. Therefore, customer service for the purpose of this thesis will be defined by the author as the ability of the transportation agency to satisfy customer demands for movement of supplies and equipment to various locations in the theater of operations.

In this context, customer service includes the delivery of equipment or supplies on time in a location accessible and

desirable to the customer. Furthermore, it includes the flexibility to move where and when the customer desires. In summary, customer service for this analysis can be viewed as the ease of access by the using unit to supplies and equipment.

Customer service is also a function of equipment required for handling containers. However, for this analysis, customer service will be isolated as a criterion for measurement, with force level requirements addressed separately.

2. Force Level Requirements

Force level requirements refer to the physical assets needed for accomplishing the container movement mission. This includes personnel as well as equipment requirements. The force level element is the other important criterion of this analysis, since some level of force structure is required to support any alternative proposed.

A sub-element of the force structure aspect is the requirement that any assets needed to accomplish each proposed alternative are either available now in the Army inventory or are planned for implementation as discussed in Chapter II of this thesis. Differences between currently fielded equipment and proposed future developments will be factored into the analysis as warranted.

3. Congestion on Road Networks

The main factors of this criterion are vehicle density on a particular route and the ability of the route to handle such densities. In general, the effect upon road congestion must be weighed to determine whether the proposed level of shipment of containers is possible over the existing road network. This area is partially tied to the equipment requirements, since certain types of trucks may be needed for forward movement of 40 foot containers. The road network must be sufficient to accommodate these vehicles in order for an option to be feasibly considered. For this analysis, however,

the equipment discussion will be isolated initially from any road congestion issues.

A further area of consideration is the effect, if any, of increased transportation traffic on the maneuver units in the area. Clearly, any adverse effect upon the mobility of maneuver units due to road congestion must be included in the consideration of alternatives.

4. Efficiency of Material Handling Operations

The efficiency of material handling operations refers to the use of available resources in such a way as to achieve the most benefit from the least expenditure of either machinery or personnel. A consideration involving the machinery aspect is whether a sufficient workload exists to justify placement of material handling equipment (MHE) at proposed locations to support the options available for implementation.

The idle time of MHE at one location may be viewed economically as lost productivity of the MHE if it were to operate at some other location. This factor is referred to as the opportunity cost of keeping the machinery at a particular site. (Pindyck and Rubinfeld: p. 198) Ideally, the opportunity cost of idle equipment should be kept as low as possible. Therefore, the efficiency of material handling operations criterion will, in large measure, weigh the opportunity cost of having the equipment at the specified location to support a particular option.

5. Optimization of the Container Capacity

This criterion will address the aspect of fully loaded containers. As discussed previously, a developing doctrine is the concept of unitization, where all items needed for a particular unit are placed in one container. At some level of organization, the 40 foot container will be sub-optimized, or less than fully loaded. Transportation operations are more efficient when all available container space is filled and containers are stuffed to capacity. Therefore, the topic of

container optimization in the context of load capacity is relevant to a discussion of the proper shipping location of 40 foot containers.

B. TYPES OF MOVEMENT

In addition to the criteria listed above, the category of movement must be addressed as well. As stated in previous chapters, this thesis will address the movement of organic unit supplies and equipment under surge deployments, the initial surge of general supplies into the theater, and finally the sustainment shipment of supplies and equipment into the mature theater of operations.

1. Organic Unit Movement

This category will include all containerized equipment or supplies that move with the unit when deploying to a contingency theater of operations. Traditionally, Army doctrine and unit commanders have tried to move the unit as a single entity whenever possible, maximizing unit integrity during deployments/redeployments. (AR 56-4: p.6) As stated by Green:

> Unit commanders are especially concerned about the ability to have their unit arrive at the Port of Debarkation (POD) relatively intact. They are also extremely concerned with intransit visibility of their equipment. Breaking units apart into several elements and the resultant loss of control, coupled with poor visibility of these shipments, is naturally stressful to the commander. Acting upon these concerns, unit commanders may pressure transportation providers to tailor the deployment around the unit, in order to ensure it arrives intact and before other units. (Green: p.26)

Clearly, this type of movement has inherent challenges to overcome that other types of movement do not necessarily need to address. For this purpose, organic unit containers will be addressed as a specific type of movement.

2. Initial Surge of General Supplies

Once units begin initial deployments into a theater of operations, cargo will be pushed to the theater in rapid fashion to build up supplies as needed by ground commanders. This can lead to a difficult period of trying to establish structures to cope with the amounts of supplies and equipment arriving in theater. As stated by Pagonis:

> In the midst of on-again, off-again chaos, we stuck doggedly to our basic, three-phase structure: reception, onward movement, and sustainment...The situation was simply too overwhelming to grasp fully and to structure in those early weeks. (Pagonis: p.95)

As noted, the specific issue pertaining to surge shipments of general cargo is the capability on the ground in theater for processing the large initial volume of containers. This aspect poses a different set of logistical problems for the transportation agency attempting to move supplies.

3. Sustainment Shipments to a Developed Theater

As more units and equipment arrive in a theater of operations, an infrastructure can be organized to provide support for the theater. In such a developed theater, the resupply and sustainment mission receives the logistical emphasis. (FM 100-5: p.64)

To facilitate this phase of an operation, units must receive a multitude of items, including spare parts and equipment. Most of this resupply arrives by container since food, fuels and ammunition are 100 percent containerizable, repair parts 80 percent containerizable, and barrier material 75 percent containerizable. (Ebertowski: p.18)

Since such a large amount of material is container compatible, this movement type must be addressed in the discussion of shipping the 40 foot container.

C. MEASUREMENT METHOD

In analyzing the various courses of action using the criteria and movement types expressed above, some form of measurement must be used to differentiate between alternatives. This thesis will use a numeric value scale and weighted decision matrices to determine the best courses of action for each of the three proposed movement types. This method is modeled on the decision matrix format, with criteria and courses of action assigned numbers based upon comparison to a defined scale.

The scale will be a numeric representation from one to five, with definitions assigned for numbers one, three and five. A rating of five for a particular area will denote a highly favorable impact of the criterion on the course of action represented. Conversely, a rating of one will denote a highly unfavorable impact of the criterion on the course of action. Finally, a rating of three will denote a marginal impact of the criterion on the course of action. In short, higher numbers reflect more desirable options.

The numbers assigned as described above will be incorporated into a weighted value decision matrix for the purpose of evaluating various courses of action for moving 40 foot containers. The software used for matrix analysis is the Military Applications Program Package from the Combined Arms and Services Staff School, Fort Leavenworth, Kansas, October 1990. The criteria used in each scenario of movement will be the five discussed previously. The following weights will be assigned to each criterion in the analysis:

- Customer service: weight of four.
- Force structure: weight of three.
- Container optimization: weight of two.
- Material handling efficiency: weight of two.

• Road congestion: weight of one.

Table 1 is a sample of the table which will be used in the analysis process. Each of the empty cells in the matrix will be filled with a number from one to five, based upon the effect of that criterion upon the particular course of action.

Criteria\ Course of Action	**Weight**	**SPOD**	**EAC**	**Corps**	**Division**
Customer Service	4				
Force Structure	3				
Container Optimization	2				
MHE Efficiency	2				
Congestion	1				
Totals					

Note: a "*" will denote the best course of action

Table 1 Sample Decision Matrix Table

1. Customer Service

As stated previously, the mission of transportation is to provide a service to the customer. As a result, this area is the most important criterion to consider when discussing courses of action, and thus warrants a weighting of four.

2. Force Level Requirements

Force level requirements are the second most important elements to consider when analyzing courses of action. As stated earlier, containers cannot be moved without required equipment to handle them in forward locations.

3. Container Optimization

The attempted trend of the Army toward unitization along with vessel efficiencies discussed earlier dictate an additional weighting of this criterion as well. Less than fully loaded containers do not enhance the overall transportation operation, and are inefficient for large scale operations.

4. Material Handling Efficiency

As stated earlier, the opportunity cost of MHE at forward locations must be considered. Since MHE is a critical shortage, its use must be watched carefully for waste and idle time. Time spent idle in the forward areas is time not spent moving containers in rear areas. Thus, this criterion must be weighted as a factor of two.

5. Road Congestion

Road congestion, while significant, is not so critical as to warrant significant additional weighting in this model. The author's experiences in Operations Desert Shield and Desert Storm proved that roads can be built if needed to alleviate road congestion, as occurred in Saudi Arabia. Therefore, a factor of one is appropriate for this criterion.

D. PROPOSED COURSES OF ACTION

Based upon the information previously presented and the criteria developed, four options appear as the most likely alternatives to the problem of how far forward to ship a 40 foot container. They are:

- Unload the containers at the SPOD.
- Ship the containers to EAC level.
- Ship the containers to corps level.
- Ship the containers to division level.

The option of shipping 40 foot containers below the division level does not seem feasible in light of discussions presented earlier regarding the difficulties encountered at levels below the division. Therefore, this option is not included in the analysis and is dismissed as infeasible in light of current and future military trends.

IV. ANALYSIS

A. SURGE OF ORGANIC UNIT EQUIPMENT

Under this scenario, units will deploy with their equipment and containers, packing the containers at the origin with items needed for operations in theater. The equipment is presumed to be needed by the units upon arrival in theater or shortly thereafter. Table 2 shows the results of the analysis of courses of action in numeric form, using weights and values generated by the author. As delineated in the table, the best course of action during the surge of organic unit equipment is to ship 40 foot containers only as far as the EAC level. An analysis of the different courses of action and the rationale for assignment of values now follows.

Criteria\ Course of Action	Weight	SPOD	EAC	Corps	Division
Customer Service	4	1	2	3	5
Force Structure	3	5	5	2	1
Container Optimization	2	5	5	4	1
MHE Efficiency	2	5	5	3	2
Congestion	1	5	4	3	2
Totals		44	47*	35	31

Note: "*" denotes best course of action

Table 2 Surge Movement of Organic Unit Equipment

1. Unload Containers at the SPOD

This option would send 40 foot containers as far as the SPOD, where they would be unloaded, emptied, and returned to the carrier for retrograde operations. The equipment or cargo in the containers would be loaded into smaller containers or on some other mode of transport for further shipment to the final destination. The tradeoffs of this course of action are now discussed in the context of the criteria shown in Table 2.

a. *Customer Service*

Customer service under this course of action would be adversely affected by shipping the containers only as far as the SPOD. The customer does not receive his supplies or equipment in a timely fashion in a suitable location. Furthermore, the flexibility to deliver or move the cargo to forward locations is greatly diminished. This course of action has the most adverse effect upon customer service of any courses of action under this scenario. Since the effect on customer service is such an adverse effect, a poor rating of one is appropriate for this criterion.

b. *Force Structure*

As noted in Chapter II, the force structure to process equipment and containers in this phase is located at the ports with host nation equipment or is facilitated by the arrival of the CTC units to conduct ship offloading and container movement. Since the CTCs will be able to process containers at the port in the times required, this criterion is affected positively by the course of action presented. Therefore, a rating of five is appropriate in this case.

c. *Container Optimization*

Under this course of action, containers would be unstuffed at the SPOD and returned to the carrier for other operations. In the case of military owned containers, the 40 foot boxes would be available to return to CONUS rapidly, minimizing turnaround time. Transit time of the empty

container would be reduced to the shortest possible time of any course of action. Therefore, the container would make more trips, hauling more cargo in the long run. For these reasons, a rating of five is appropriate for this criterion.

d. *MHE Efficiency*

The use of MHE in theater will be optimized by keeping the equipment busy during operations. The SPOD is the best place to keep MHE continuously processing containers, since the requirement exists to load and unload containers from ships and transload to other transportation modes. Since keeping MHE in the SPOD is the most efficient use of the equipment under this scenario, a rating of five is warranted.

e. *Congestion*

The effect of shipping containers to the SPOD upon road network congestion is minimal in a direct sense. However, indirectly, the unloading of containers at such a rear location could cause traffic bottlenecks as less efficient transportation methods are used to move the cargo and equipment further forward. These bottlenecks could impede the flow of maneuver unit traffic at some point. In all likelihood, the bottlenecks will be generally in a more rear location than forward when looking at the whole theater. Because of the minimal impact upon forward units, a rating of five is warranted.

f. *Summary*

The option of shipping containers to the SPOD keeps container empty time to a minimum. It also facilitates the best use of MHE that is providing support for ship unloading operations. The force structure needed for this option is either fully in place or under development. Furthermore, the road networks may not be congested in forward locations. However, the potential exists for congestion by less efficient

transport vehicles. Finally, and most importantly, this course of action does not provide a high level of customer service.

2. Ship Containers to Echelons Above Corps

Under this course of action, 40 foot containers would be shipped to EAC locations, emptied and returned to the shipper or the SPOD for future operations. The cargo would be transloaded to other vehicles for shipment to the final unit, or the customer would be notified to go pick up the equipment or cargo. Based upon the author's experience in Operations Desert Shield and Desert Storm, the latter possibility could occur under this course of action.

a. Customer Service

Under the EAC option, customer service is slightly improved over the option of unloading containers at the SPOD. Units still do not have the containers in desired locations when they want them, and they lose an element of flexibility for future operations. Therefore, a rating of two is appropriate.

b. Force Structure

Again, the force structure is fully in place at EAC level to handle containers in the EAC area, since the EAC commanders will control the CTCs as discussed in Chapter II. Therefore, a rating of five is appropriate here as it was for the previous course of action.

c. Container Optimization

Containers under this option can be quickly turned around with minimal time in transit as empty containers. Furthermore, the containers at this level are still certain to be filled completely, with no wasted space. For these reasons, a rating of five is given.

d. MHE Efficiency

As noted earlier, the control of MHE during this scenario rests with the EAC commanders. Therefore, the CTCs and all other MHE will be at the EAC level for maximum utilization. Since the volume of containers arriving in the EAC area will still be large as demonstrated in Chapter III, there will be sufficient workload to keep all MHE continuously operating with minimal travel time between loading locations. Therefore, a rating of five is warranted.

e. Congestion

As stated in the previous course of action, the effect on road congestion in the EAC area is relatively minimal as it impacts upon final destination units. However, the possibility does exist for congestion due to the secondary effects of more vehicles using the road network with less efficient methods of transport. These effects will be more pronounced than at the SPOD level. As such, a rating of four is appropriate.

f. Summary

This option provides many of the same benefits as the course of action outlining shipping containers to the SPOD. The biggest improvements are in the area of customer service, where the customer gets the containers closer to his final destination. The force structure still exists to provide such service, and this option makes excellent use of available MHE. However, there is still some limitation of the flexibility of units to move with 40 foot containers shipped to the EAC level.

3. Ship Containers to the Corps

Under this course of action, the containers would be shipped down to corps level, where they would be unstuffed and then returned to the system for use in further operations.

a. Customer Service

When shipping 40 foot containers to the corps level, customers receive their equipment closer to the final destination than either of the two previous courses of action. However, the contents of the container must still be transported by other means to the final unit destinations. Because the unit commander does not have complete flexibility under this course of action, a rating of three is appropriate.

b. Force Structure

At the corps level, a noticeable lack of force structure exists during this scenario. As stated in Chapter II and previously under other courses of action, the CTCs will be under EAC control offloading ships arriving in theater until the arrival of follow-on forces. As follow-on forces arrive, the CTCs will be tasked to the corps for support of corps MHE functions. During the initial surge of unit equipment, it is highly unlikely that the corps will receive sufficient assets to successfully accomplish the 40 foot container movement missions. Therefore, a rating of two is warranted.

c. Container Optimization

As in previous courses of action, 40 foot containers will be stuffed full with no wasted space at the corps level. It is also likely that, while not as quick as previous options, the containers will be turned around fairly quickly. The minor degradation in turnaround time justifies a rating of four in this case.

d. MHE Efficiency

At the corps level, the possibility exists that MHE will be required to move to various locations in the theater to conduct container movement missions. As containers are shipped to lower echelons, the density of containers at a particular location diminishes as well. This diminished density may result in the requirement for MHE to be

transported to different locations for container operations. When the MHE is being transported, it is not conducting container movement operations. Therefore, the MHE may be better used in areas where movement of the equipment is minimized. For this reason, a rating of three is warranted.

e. Congestion

As the containers are transported to the corps level, the number of large trucks carrying 40 foot containers increases. These trucks may have difficulty traveling the road networks of the corps area. As a result, congestion may occur. Furthermore, the appearance of container trucks in the corps area naturally brings the road congestion to a higher level for maneuver units. At this level, however, the effect will still be relatively small. Therefore, a rating of three is appropriate.

f. Summary

Shipping containers to the corps area increases the level of customer service by moving the cargo and equipment closer to the final destination. However, the major drawback is the fact that MHE may not be available in sufficient quantities to move the containers as they arrive. Furthermore, the container handlers will be less efficient because of the increased transit requirements. These drawbacks may outweigh the benefits of moving 40 foot containers to the corps area.

4. Ship Containers to the Division

Under this course of action, the 40 foot containers would be moved to division level, where they would be unloaded and returned to the system for future missions.

a. Customer Service

Clearly, this alternative provides the highest level of service from the standpoint of having cargo and equipment

on time in a preferred location. For this reason, a rating of five is warranted.

b. Force Structure

As noted in the previous example, the CTCs will not be available to support movement below EAC in this scenario. It is a near certainty that the division will not have MHE dedicated for their use in moving 40 foot containers. As a result, they will be relegated to obtaining container support as outlined in Chapter II, begging anyone who has the equipment for some usage time. Due to this nearly total lack of handling capability, a rating of one is clearly required.

c. Container Optimization

Based upon the author's experience, it is difficult to load 40 foot containers to their fullest capacity when shipping to the division level. As a result, sub-optimization of the container may occur. Similarly, the container will take longer to return to the container pool for future actions than under any of the other courses of action. For these reasons, a rating of one was assigned.

d. MHE Efficiency

When there is little or no MHE capable of handling 40 foot containers in the division area, it is difficult to gauge MHE efficiency. The available MHE, if any exists, will have a large workload in proportion to the amount of MHE on site. However, transit time between sites will still be required to place the MHE where it is needed. Therefore, a rating of two is appropriate.

e. Congestion

When moving 40 foot containers to the division area, it is possible that some roads may be difficult if not impassable for the trucks to negotiate. Coupled with the added number of vehicles on the road hauling containers in the maneuver unit area, congestion may be greatly increased over

other courses of action presented. Therefore, a rating of two is assigned.

f. Summary

The customer service level provided by shipping 40 foot containers to the division level is the highest among the options presented. However, in this scenario, little or no MHE will be available to perform the container handling mission. Therefore, the gain in customer service is more than offset by the inability of the unit to move containers.

5. Sensitivity Analysis

When developing tables with relative values, it is sometimes useful to conduct an analysis to determine whether changing a parameter will have an effect on the outcome. The analysis of parameter changes and their effect on model solutions is known as sensitivity analysis. (Taylor: p.145) For the purpose of this model, the parameters examined will be the weights assigned to each of the criteria as discussed previously with the goal of determining the effects, if any, on the model solution. In other words, if the criteria weights are changed, will the best solution change?

In this case, using the Military Applications Program Package discussed earlier, the model was determined to be sensitive in the areas of customer service and congestion. In other words, changing the criteria weights one at a time by as much as three units in either direction has some effect on the best solution.

Customer service became sensitive at a criterion weighting of one, with the best solution being a tie between shipping containers to EAC level and unloading them at the SPOD. In other words, if customer service was deemed to be no more important a criterion than road congestion, then containers should be unloaded at the SPOD or at EAC level. For this model, however, customer service has been established

as the primary consideration of importance. Therefore, the model remains valid for this criterion.

The criterion of road congestion became sensitive at a weighting of four, with the best solution again being a tie between unloading containers at the SPOD and shipping them to EAC level. Therefore, if road congestion was deemed so important a criterion that a weighting of four was warranted, the best solution would be to either unload containers at the SPOD or ship them to EAC levels. For this model, it has been established that congestion is not of paramount concern. For these reasons, the model solution as presented may be considered as valid.

6. Scenario Summary

The best course of action for this scenario is to ship the containers no further than the EAC level. The CTCs will not be available for use below EAC in this phase, since they will be performing port clearance operations. Therefore, the units will not have sufficient capability to process the 40 foot containers. A lack of MHE at lower levels, coupled with the initial congestion and surge efforts make movement of the 40 foot container impractical below this level.

B. INITIAL SURGE OF GENERAL SUPPLIES

This scenario includes items deemed important for initial theater buildup and support. Among the items sent during the surge of general cargo may be barrier material, clothing replacement or augmentation, food, water, and general repair parts for common vehicles. Some of this equipment will be sent for specific units while other equipment may be sent to depots in the EAC area or to a Corps Storage Area (CSA).

Table 3 shows the results of analyzing the various courses of action in numerical form. As noted in the table, the best course of action during the surge of general cargo is to ship 40 foot containers no further than the EAC level.

Criteria\ Course of Action	Weight	SPOD	EAC	Corps	Division
Customer Service	4	1	3	4	5
Force Structure	3	5	5	2	1
Container Optimization	2	5	5	4	2
MHE Efficiency	2	5	5	2	2
Congestion	1	5	4	3	2
Totals		44	51*	37	33

Note: "*" denotes best course of action

Table 3 Surge Movement of General Cargo

1. Unload Containers at the SPOD

This scenario presents the same issues regarding 40 foot container movement as the situation presented under the surge of organic unit equipment, with the same considerations for all criteria. The major difference is the fact that more units will be in theater than under the surge of organic unit equipment scenario. However, this difference does not warrant significant changes for unloading considerations at the SPOD. Therefore, the weights are the same in this scenario for this course of action as they were for the surge movement of organic unit equipment.

2. Ship Containers to Echelons Above Corps

The criterion of customer service in this scenario differs significantly when compared with the movement of organic unit equipment. All other criteria are not significantly different to warrant additional discussion in this section. The customer service difference is now discussed.

a. *Customer Service*

The key element in this scenario is the fact that units will be arriving and setting up for operations, having already received their organic equipment. Therefore, shipping containers to EAC storage depots brings the supplies closer to the final unit than unloading at the SPOD. As discussed in Chapter III, the structure will be in the early formation stages, with facilities being set up to accommodate such equipment. Therefore, the gain from shipping to EAC levels in customer service warrants a rating of three.

b. *Summary*

As mentioned previously, other considerations regarding shipping containers to EAC levels are not significantly different from those mentioned in the previous scenario. Therefore, the increase in customer service is the primary issue of improvement under this course of action.

3. Ship Containers to Corps

The areas of significant difference under this course of action pertain to customer service and MHE efficiency.

a. *Customer Service*

Shipping containers to the Corps area provides greater benefit to the final unit since the unit will presumably have its equipment on hand. Thus, transporting the cargo or supplies from corps levels to final units will be easier to accomplish. For this reason, a rating of four is appropriate.

b. MHE Efficiency

As more units arrive and more cargo arrives in theater, the requirement for MHE to handle containers will naturally rise. In the surge stages of deployment, the CTCs will still remain at the EAC levels to provide needed support. Therefore, the corps will have the same MHE shortfall experienced earlier. When the same assets are spread over a much larger demand area and quantity, efficiency will drop dramatically. Therefore, a rating of two is required.

c. Summary

This option provides higher customer service than the two previous courses of action presented. However, the MHE shortfalls are exacerbated by an increased demand for the assets in theater. Therefore, the benefits of shipping 40 foot containers to corps level may again be offset by a lack of MHE to handle the containers.

4. Ship Containers to the Division

This course of action differs significantly from the previous scenario in the area of container optimization. All other areas of this option are adequately similar to the issues discussed under surge movement of organic equipment.

a. Container Optimization

The possibility of filling 40 foot containers to capacity is greater in this scenario because the containers will be arriving from depot level activities in CONUS. If the 40 foot container is used, commercial and military depot level activities will attempt to fully load the container. Therefore, the division is more likely to receive a full container than a sub-optimized one. However, the long delay in returning containers to the system, coupled with the problems noted previously, warrant a small increase in the rating assigned. Thus, a rating of two is given.

b. Summary

The option of shipping 40 foot containers to the division level is still fraught with difficulties, as expressed earlier. The division will still have the problem of handling the containers they receive.

5. Sensitivity Analysis

A sensitivity analysis was also conducted for this model. In this case, the model was demonstrated to be not sensitive to changes in the weights of all criteria. In other words, changing the weights as noted previously had no effect on the best solution.

6. Scenario Summary

The best course of action under this scenario is to ship 40 foot containers no farther than the EAC level. The differences in the courses of action are more pronounced in this scenario because of the increased workload upon the corps, performed with essentially the same MHE on hand. Therefore, the corps and division levels will not be able to adequately handle 40 foot containers that are shipped to their level.

C. SUSTAINMENT SHIPMENT OF GENERAL CARGO

Under this scenario, the theater will be a mature area of operations with full support personnel and equipment on hand to receive and transport supplies and equipment. This situation is fundamentally different from the previous two scenarios, and requires separate analysis in most areas.

Table 4 displays the results of the analysis of courses of action under this scenario in numeric form. As noted in the table, the best course of action during sustainment shipments of general cargo is to ship 40 foot containers to the corps level. At the corps level, the containers would be unstuffed and returned to the transportation system.

Criteria\ Course of Action	Weight	SPOD	EAC	Corps	Division
Customer Service	4	1	3	4	5
Force Structure	3	5	4	4	1
Container Optimization	2	5	5	4	1
MHE Efficiency	2	4	4	4	2
Congestion	1	5	4	3	2
Totals		42	46	47*	31

Note: "*" denotes best course of action

Table 4 Sustainment Movement of General Cargo

1. Unload Containers at the SPOD

The general method of operations remains the same as in the previous two scenarios presented. However, there are significant differences which must be analyzed in this particular scenario that are independent of the other scenarios previously discussed.

a. Customer Service

The lack of customer service in this course of action is more obvious than previously noted, since more resources will be in theater to move the cargo forward. This aspect will be discussed under force structure. However, for the criterion of customer service, a rating of one is appropriate.

b. Force Structure

Clearly, the force structure will exist in a mature theater of operations to unload containers at the SPOD. Follow-on forces will have arrived, releasing the CTCs to corps levels as needed to provide needed container handling support. Because of the theater reaching the maximum container handling capability during this scenario, a rating of five is appropriate.

c. Container Optimization

Similarly, 40 foot containers will be turned around rapidly at the SPOD, as in the two previous scenarios. Therefore, a rating of five is warranted for this criterion.

d. MHE Efficiency

The theater will have a greatly increased container handling capability during the sustainment phase of an operation. Therefore, there will be more MHE in lower levels to accomplish the container movement issue. Because this additional capacity is not at the SPOD, the cost of unloading containers at the SPOD may be the idle time of MHE at lower echelons in the theater. Therefore, a rating of four is appropriate.

e. Congestion

Congestion at the port will be alleviated somewhat by the departure of units to the theater of operations. Furthermore, the structure will be in place to clear the port more rapidly than under other scenarios. However, the same possibility exists of potentially clogging road networks at lower echelons with less efficient transport vehicles due to the unloading of 40 foot containers at the SPOD. However, the minimal impact upon units warrants a rating of five.

f. Summary

Unloading containers at the SPOD during sustainment operations results in the fastest turnaround time for the container. However, the problems associated with a lack of

customer service and possible road network congestion make this option less desirable during the sustainment phase. Under this scenario, the force structure exists to make better overall use of the system and benefit the customer by moving the containers to lower echelons.

2. Ship Containers to Echelons Above Corps

This course of action is similar in substance to the methods outlined under previous scenarios. However, significant differences exist regarding most of the criteria under this option.

a. Customer Service

Again, in a mature theater of operations, the corps will be fighting a fluid battle in a developed theater. Containers that are delivered to the EAC area still somewhat limit the flexibility and response time of the corps to fill customer demands. Therefore, a rating of three is warranted for this criterion.

b. Force Structure

The force structure will be in place to easily handle containers under this scenario. However, moving containers in the field environments of EAC forces is not as effortless as conducting those same operations in the SPOD. Therefore, a rating of four is appropriate.

c. Container Optimization

Containers should still be optimized as in previous scenarios, for the same reasons discussed earlier. A rating of five is therefore given.

d. MHE Efficiency

Shipment of containers to EAC levels should not pose a problem in the mature theater with handling assets still abundant in proportion to levels during other scenarios discussed earlier. However, the transit time of MHE will still have a negative effect on the full use of the equipment. Therefore, a rating of four is appropriate.

e. Congestion

Congestion will be a minor factor in the EAC area, as discussed previously. However, the potential still exists for less efficient transport methods to clog road networks. For this reason, a rating of four is appropriate.

f. Summary

The increase in customer service is significant when compared with the option of unloading containers at the SPOD. However, in the developed theater, the 40 foot containers can be handled more readily at lower echelons. Therefore, the option of shipping 40 foot containers to the EAC level is good, but not the best.

3. Ship Containers to the Corps

Shipping containers to corps level appears to be the best course of action under this scenario. The specific criteria weights are now discussed.

a. Customer Service

As in previous scenarios, the customer service levels are more favorable as the containers are moved to lower echelons. Therefore, a rating of four is appropriate for this criterion.

b. Force Structure

The critical element of force structure is the allocation of the CTCs to the corps for the container handling mission. As discussed previously, once follow-on forces arrive, the CTCs will be task organized to the corps for use as appropriate. Because of the MHE augmentation, a rating of four is warranted for this criterion.

c. Container Optimization

Containers can still be optimized when shipping 40 foot containers to the corps level for the reasons discussed earlier. The corps is large enough to provide a steady demand for full 40 foot containers. However, turnaround time will

still be greater than with the two previous courses of action. Therefore, a rating of four is given.

d. MHE Efficiency

Since the CTCs will be operating in the corps area, the demand for handling assets will keep the equipment operating on a fairly continuous basis. The only possible delays include the transit times as noted earlier to move among different locations. For this reason, a rating of four is appropriate.

e. Congestion

As noted previously, congestion will increase as the 40 foot containers move to lower echelons. However, the increased vehicle size may result in fewer numbers of less efficient transport vehicles on the road at any given time. Since these areas seem to balance themselves, a rating of three is given.

f. Summary

Shipping 40 foot containers to the corps level under sustainment operations is possible because of the increased handling capability gained by augmentation from the CTCs. Without this augmentation, handling containers at the corps level would be very difficult.

4. Ship Containers to the Division

Shipping containers to the division level under this scenario presents no significant differences in evaluative methods from the scenario of surge movement of organic unit equipment. The only possible difference that may impact upon this course of action under sustainment operations is the augmentation of the corps by the CTCs. However, there is no guarantee that this augmentation will ever manifest itself at the division level in significant numbers to warrant additional consideration. Therefore, all ratings for the criteria under this course of action are identical to the ratings provided under surge movement of organic unit

equipment. The division still does not have sufficient capability to handle 40 foot containers adequately.

5. Sensitivity Analysis

A sensitivity analysis conducted on this scenario model revealed three criteria which were potentially sensitive to changing weights. Those criteria were customer service, container optimization and congestion.

The customer service criterion became sensitive at a weight of three, where the best solution then became a tie between shipping the containers to EAC level or to the corps level. In other words, if customer service was deemed to be of equal importance as force structure, the best choice would be to unload 40 foot containers at EAC level or the corps level. However, it is clear that customer service must be weighted most heavily of all the criteria for reasons discussed in Chapter III.

The container optimization criterion became sensitive at a weighting of three, with a strategy tie again between shipping to the EAC or corps levels. However, as noted previously, force structure and customer service must be the two key criteria of importance in this analysis.

The congestion criterion became sensitive at a weight of two, where the best choices were either shipping the containers to EAC or corps level. In other words, if the aspect of congestion was deemed so critical as to warrant a weighting of a factor of two, then two best solutions existed. However, it is difficult to place congestion on the same level of emphasis as the other criteria for the reasons discussed in Chapter III.

In summary, while this scenario model did show some sensitivity to changing criteria weights, the changes would have to occur in highly unlikely areas of emphasis. Therefore, the model may be considered valid as presented for use as an evaluative tool.

D. CHAPTER SUMMARY

In this analysis, three scenarios were presented with four possible courses of action listed for each scenario regarding the shipment of 40 foot containers. The three scenarios presented were surge movement of organic unit equipment, surge movement of general cargo, and sustainment shipment of general cargo. The four courses of action were:

- Unload containers at the SPOD.
- Ship containers to EAC level.
- Ship containers to corps level.
- Ship containers to division level.

When considering the movement of organic unit equipment, the best alternative was to ship the 40 foot containers no further than EAC level. The rationale was primarily that the units could not handle containers adequately below that level.

The shipment of surge containers carrying general cargo was also best completed by sending 40 foot containers no further than EAC level. The rationale was similar to the discussion regarding shipment of organic unit equipment.

Finally, the shipment of sustainment supplies could best be completed by moving 40 foot containers to the corps area. This level of shipment is made possible by the arrival of CTCs in the corps area in the mature theater of operations.

V. CONCLUSIONS AND RECOMMENDATIONS

Containerization will play a significant role in the movement of units and equipment to contingency theaters of operation in the forseeable future. As such, it is vital to develop and refine transportation doctrine and systems to gain the most benefits from containerized operations.

The Army is moving toward a 20 foot standard container, but the commercial industry has been shifting to a 40 foot standard for many years. It is still unclear whether these divergent paths will adversely affect military containerization.

Clearly, the Army would prefer not to use 40 foot containers if at all possible. The areas of research into past problems of handling 40 foot containers validate the Army position that 40 foot containers are difficult to manage in a military wartime context. This difficulty arises as a result of the requirement for military units to remain mobile in their task organizations. As such, units do not have the material handling equipment to conduct movement of 40 foot containers.

The trend in military transportation developments has been to improve the delivery and transport methods of vehicles capable of carrying 20 foot containers. Therefore, the Army should continue to move toward standardizing the 20 foot container for contingency operations, and thus minimizing the use of 40 foot containers.

Since research demonstrated a probable existing requirement for employment of 40 foot containers for contingencies, the Army must specifically address this issue. However, no single doctrinal system of employment of containers will fit into every scenario envisioned for a contingency theater of operations. Nevertheless, general concepts may be applied toward the potential employment of 40

foot containers in any theater of operations. These concepts specifically relate to the shipment of 40 foot containers to various locations in the theater during different phases of an operation.

As a general rule, the transportation system should ensure that no unit deploys to a theater of operations with organic unit equipment in 40 foot containers. Analysis has shown that 40 foot containers are extremely difficult to handle at the corps and lower level during surge deployments of both general supplies and organic unit equipment. The 20 foot container appears to be better suited for this aspect of transportation operations. Clearly, the 40 foot container is not the recommended solution to forward movement of equipment and supplies at this early stage of a potential conflict.

Furthermore, 40 foot containers should be shipped only as far as the corps area during sustainment operations, where they would be unloaded and returned to the transportation system for further missions.

The recommendation to ship 40 foot containers to the corps level during sustainment operations rests largely upon the successful fielding of the Cargo Transfer Companies as they are now envisioned in both structure and mission statements. Should either of these aspects change significantly prior to the requirement for employment in a theater of operations, the level of shipment of 40 foot containers must also be addressed. At the tactical level of war, the availability of MHE is vital to the ability to accomplish the 40 foot container movement mission.

Other areas of significance were analyzed in the context of providing the means of delivering supplies to the customer. These areas included the optimization of containers as well as effects of container movements on road congestion in the theater. However, all other considerations are secondary to the issue of providing a customer with prompt, effective

movement of his supplies and equipment in such a fashion that enables the commander to accomplish his mission. The customer service aspect of transportation operations must be the primary consideration when contemplating alternative courses of action regarding the movement of 40 foot containers. Only in this fashion will the movement of units be most effectively carried out by transportation agencies throughout the military.

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